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SYNTHESIS OF IMIDAZOLE

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ABSTRACT

A simple approach was used to prepare concentrated nitric acid supported on nano silica (HNO3@nanoSiO2). The synthetic powder was used as an efficient catalytic system for the synthesis of different 2,4,5-trisubstituted imidazoles in good to outstanding yields under solvent-free conditions at 100 C. Furthermore, 1,2,4,5-tetrasubstituted imidazoles have been successfully performed under the same reaction conditions. In three runs, the recovery and reusability of HNO3@nano SiO2 were tested without activity loss. In the reported technique, the main properties of this acidic Nano catalyst include high product yield, quick reaction times, green reaction media, and a wide variety of substrates usage. The theorized mechanism of cyclo-condensation is also depicted.

Keywords: Benzil; Multi-Substituted Imidazole; Benzoin; Nano Silica; Green Chemistry

INTRODUCTION

One particularly fascinating class of heterocyclic molecules is the imidazole. Imidazole is a five-membered N-heterocyclic chemical molecule with the formula C3H4N2, which has two nitrogen atoms in the aromatic ring. The compound is known by its scientific name, 1,3-diaza-2,4-cyclopentadiene, and it falls under the alkaloid category.

Heinrich Debus created imidazole for the first time in 1858. Imidazole is a component of many natural substances, including dipeptides like carnosine and anserine, which are an essential class of therapeutic substances, as well as histamine, histidine, biotin, alkaloids, and nucleic acid.The imidazole nucleus is a component of numerous bioactive heterocyclic compounds, which are highly desirable due to their varied biological and therapeutic applications. They are crucial to biological activity and metabolic processes, and they have a wide range of pharmacological qualities and uses.The poly substituted imidazoles are marketed as antibacterial, anticonvulsant, fungicides, herbicides, medicinal medicines, and P38 MAP kinase inhibitors. The majority of imidazole derivatives include antifungal, anticancer, and antihistamine properties, such as dacarbazine, metronidazole.

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APPLICATIONS OF IMIDAZOLE:

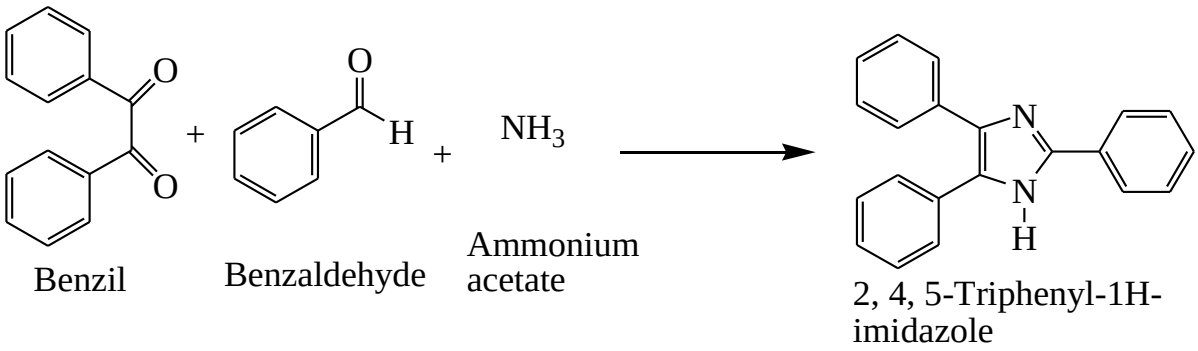
Imidazole is used in the purification of genetically tagged proteins in immobilized metal affinity chromatography (IMAC). Imidazole is utilized in the chromatography column to elute tagged proteins linked to Ni ions bonded to the surface of the beads. An excess of imidazole is pumped through the column, dislodging the His-tagged proteins from nickel coordination and releasing them.

Imidazole can be used to make buffers with pH values ranging from 6.2 to 7.8 at room temperature. It is suggested as a component of a buffer for horseradish peroxide assay. It is also utilized as a chelator to bind various divalent cations.

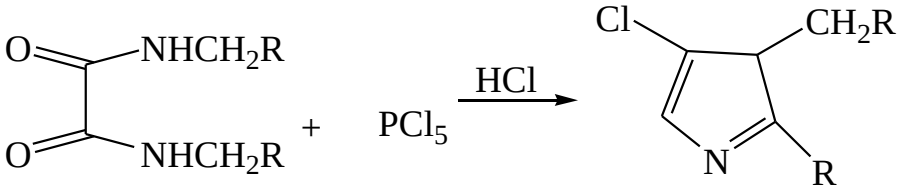
Imidazoles have been utilized in polymers, fluorescent materials, ionic solvents, N-heterocyclic carbene chemistry, and photography as a solvent.

There are several methods for the synthesis of highly substituted imidazole. The mostly used methods in the last decades are as follows:

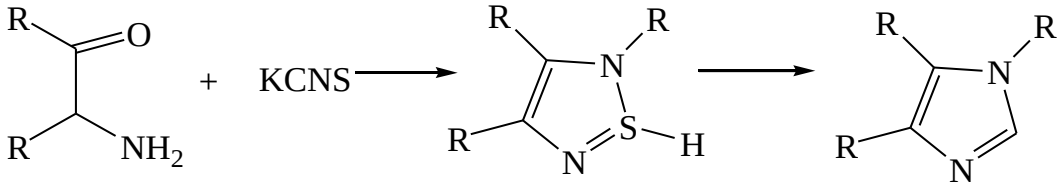
1) Radziszewski Synthesis: The condensation of a benzil and benzaldehyde in the presence of ammonia and catalyst yield 2, 4, 5-triphenylimidazole.



2) Wallach Synthesis: When N, N-dimethyl oxamide is treated with phosphorus pentachloride, a chlorine containing compound is obtained which on reduction with hydroiodic acid give N-methyl imidazole.



3) Markwald Synthesis: This method involves the action of potassium thiocyanate on α-amino aldehyde or ketone. The resulting imidazoline thione is desulphurised with Rani Nickel or by oxidation with nitric acid



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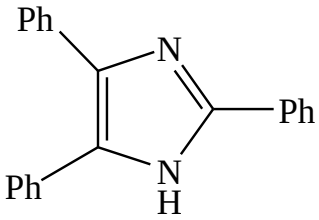
CHEMISTRY OF 2, 4, 5 –TRIPHENYL-1H-IMIDAZOLE

- **Structure:-**



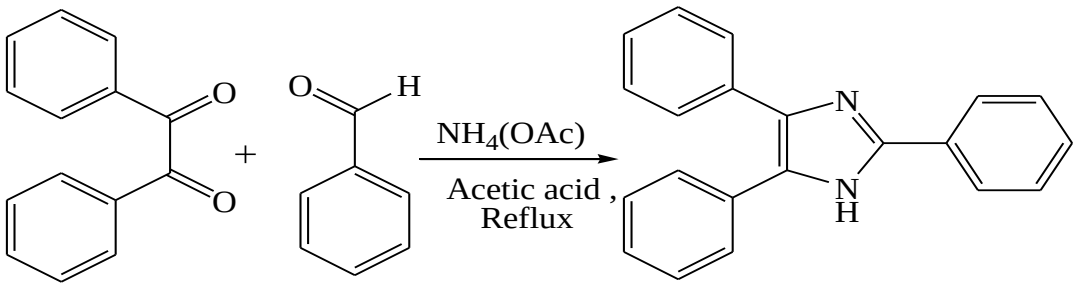
2,4,5-triphenyl-^{1}H-imidazole

- **Molecular Formula** : $C_{21}H_{16}N_2$
- **Molecular Weight** :296 gm
- **Percentage of elements contains** and weight:- : It contains on the basis of their molecular formula
  - C = 85.13%
  - H = 5.40%
  - N = 9.45%
- **Nature** : White amorphous solid.
- **Melting Point** :276 - 288^{O}C
- **Therapeutic Use** : Fungicide, antifungal, antiprotozoal, etc. It used as chemical reagent, pharmaceutical synthesis and development. It is used as a corrosion inhibitor in certain transition metals such as Copper compounds.

Reported Method:-

Reported methods for synthesis of 2,4,5-Tri-substituated imidazole:

Method 1:-



Benzil Benzaldehyde 2,4,5 -triphenyl-1H-Imidazole

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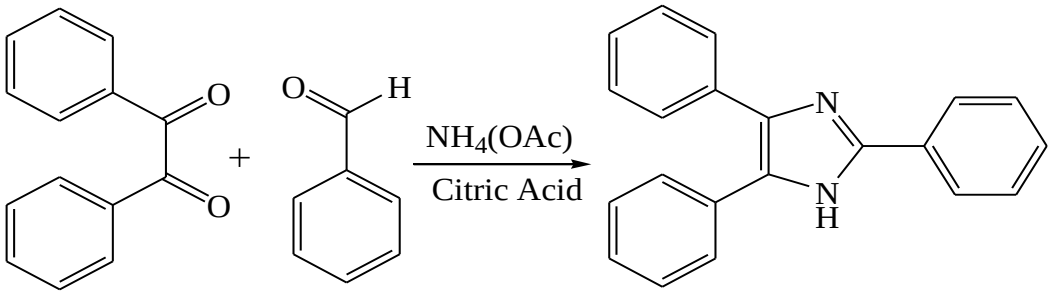
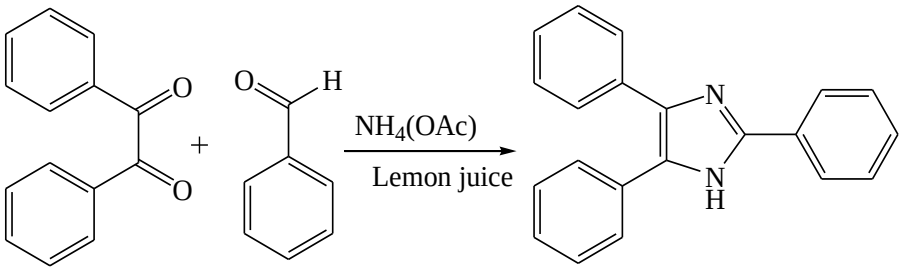
Method 2:-



Benzil Benzaldehyde 2,4,5 -triphenyl-1H-Imidazole

Method 3:-



Benzil Benzaldehyde 2,4,5 -triphenyl-1H-Imidazole

RESULT AND DISCUSSIONS

Numerous classical methods for the synthesis of substituted imidazoles have been documented, owing to their various biological activity. The outcomes of the synthesis of trisubstituted imidazole, a cheap, readily available, reusable, and non-toxic catalyst, catalyzed by L-proline. These outcomes were first attained by agitating a solution of 1 mmol of aldehyde, 1 mmol of benzil, 2 mmol of ammonium acetate, and 10 mol% of L-proline under reflux conditions.

Following the reaction's conclusion, the fluid was allowed to reach room temperature before being poured over crushed ice. After being filtered out, the solid solids were given a cold water wash. After that, a water wash was used to remove the product from the catalyst. Pure product was obtained by recrystallizing the product with ethanol.

As part of our ongoing investigation into the creation of innovative synthetic processes, we are pleased to provide a very effective technique for the synthesis of 2,4,5-triarylimidazoles, which is aided by the costly, mild, and commercially accessible organo catalyst L-proline. This procedure involves combining aldehyde, benzil, and ammonium acetate in ethanol in a single pot.

In our quest for the ideal experimental reaction conditions and solvent for the synthesis of 2,4,5-triphenylimidazoles, we conducted the identical reaction without a catalyst, yielding a 47.63% yield.We have studied the model reaction at 2.5, 5, 10, 15, and 20 mol% of L-proline in ethanol at reflux temperature in order to identify the ideal concentration of catalyst. 45.10, 51.01, 54.72, and 47.63% yields of the product were achieved, respectively. This suggests that using 10 mol% L-proline is adequate to advance the reaction. In

terms of reaction rate and product yield, the catalyst is crucial to the process's success.

CONCLUSION

Because of their high degree of atom economy and use in the diversity-oriented convergent synthesis of complex organic compounds from simple and commonly available substrates in a single vessel, multi component reactions have an exceptional reputation in organic and medicinal chemistry.Finally, wehave presented a comprehensive and very effective method for the synthesis of derivatives of 2,4,5-triaryl substituted imidazoles employing cheap, readily accessible L-proline as an organocatalyst in ethanol. This protocol's outstanding benefits include gentle reaction conditions, high product yields, and ease of operation and experimentation. This process, in our opinion, will be a useful supplement to the current techniques for the synthesis of 2,4,5-triaryl modified imidazoles.

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